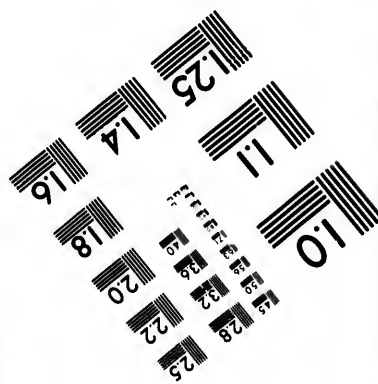
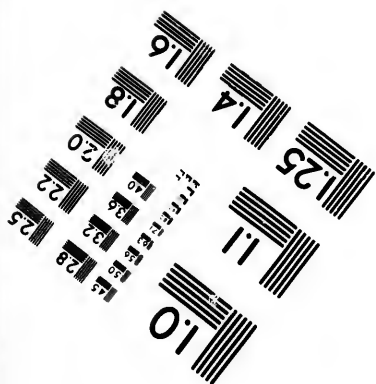
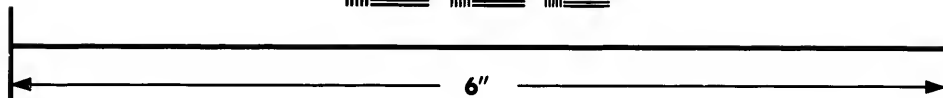
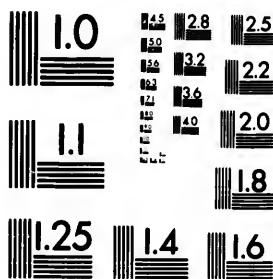
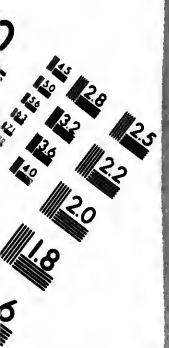


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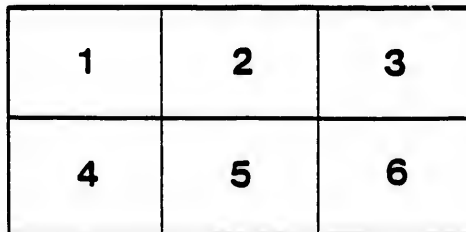
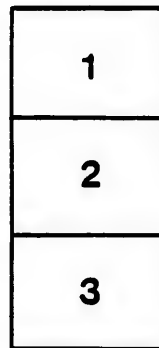
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Extracted from THE OTTAWA NATURALIST, Vol. XI, No. 9, pp. 173-176,  
Ottawa, December, 1897.

## RECENT CONCLUSIONS IN QUEBEC GEOLOGY.

R. W. ELLS, LL. D., F. R. S. C., Geological Survey, Ottawa.

(Read before Section C., British Association Meeting, Toronto, Canada, 1897.)

The paper gives a brief outline of the progress of geological exploration in this portion of the Dominion, with a statement of the most recent conclusions arrived at as the result of the detailed study of the rocks in the field. It is largely a summary of the conclusions stated in the published report of the Geological Survey of Canada,\* on this district.

The principal problems west of the St. Lawrence were the relations of the great Anorthosite masses, lying to the north of Montreal, to the Laurentian Fundamental Gneiss and the Grenville Series; and secondly, the relations of the Grenville Series itself to the underlying Gneiss on the one hand and to the Hastings Series of Ontario on the other.

These may now be regarded as fairly well settled, at least to the satisfaction of those who have most recently worked in this field. In regard to the age of the Anorthosites the old contention that these were an altered series of the sedimentary rocks, resting unconformably on the gneiss and limestone of the Grenville series, has been abandoned. It has been found that the Anorthosites and Gabbros which are associated with these, are igneous in character, and that they are newer, in point of time, than the Grenville rocks; that they have invaded these at many points and altered them along the lines of contact.

The change of view in regard to their origin dates back to about 1879-80, and their igneous intrusive character was first pointed out by Vennor nearly twenty years ago. This view was expounded by Dr. Selwyn in the report for the years mentioned, but the whole question has more recently been investigated, principally by Dr. F. D. Adams, whose observations in the field and in the laboratory have finally conclusively settled the problem and shown that the anorthosite areas are masses of igneous rocks newer than the Grenville limestone and associated gneisses.

The second grand problem as to the relations of the Grenville limestone and associated rusty and hornblende gneisses to the Fundamental Gneiss of the Laurentian proper, has also been conclusively settled. It is now held by all the recent observers in this field that the rocks of this division are a newer

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\* Annual Report, Vol. VII, N. Series, 1894, Part J.

series, resting upon the Fundamental Gneiss. In this no trace of sedimentation is now apparent; while in the Grenville series the originally clastic character is clearly recognized in several of its members. The rocks of the Grenville series have been worked out along their westward development and have been found in this direction to include the series named by Vennor, the Hastings, which is apparently the same as the Grenville, under different conditions as regards alteration and local development; the limestones of the Hastings series being frequently less altered, and associated with micaceous and other schists, along with beds of slate and true conglomerates.

*East of the St. Lawrence.*

The great problems as to the structure of the Quebec Series or Group which have been prominent for nearly fifty years have also been settled, at least to the satisfaction of those most familiar with all the aspects of the question. The crystalline series of the Sutton Mountain, at one time regarded as the newest member of the Group has been separated and placed in the pre-Cambrian division, and are presumably of Huronian age, since it has been found that these rocks underlie the lowest fossiliferous Cambrian sediments. Above these crystalline rocks there is a very considerable thickness of strata which represent the Cambrian and which have been locally assigned to the lower Sillery formation, for the sake of description; and these rocks contain, at many points, organic remains such as trilobites, graptolites, etc., which have a marked Cambrian aspect. The fossiliferous beds of the upper Sillery and Levis have been carefully searched and studied, stratigraphically, and it has been conclusively shewn that the Levis is the upper member and overlies the upper Sillery; and, that in fact the Sillery is the downward prolongation of the Levis without manifest break, except that the fossil contents become less abundant in the upper Sillery, as in the case of the passage of the Calciferous of the Ottawa Basin downward into the Potsdam sandstone, where there is also no marked line of separation, except in the change of character in the composition of the strata. There is however a marked break between the slates and sandstones of the upper Sillery and the limestones and slates of the lower Sillery; since in connection with heavy faults between the two series there are thick beds of limestone conglomerate at the base of the upper Sillery, abounding in pebbles of limestone which contain numerous specimens of *Olenellus Thompsoni*, and

other lower Cambrian fossils. In point of time the Levis beds may be regarded as the equivalents of the Calciferous of the Ottawa Basin, while the lower portion or upper Sillery may be taken as the equivalent of the Potsdam sandstone.

The rocks of Quebec City and the Citadel Hill are somewhat higher in the scale than those of the Levis shore opposite. They were at first regarded as of Levis age and lower in position than the Sillery. Subsequently they were held to represent the Hudson River and Utica divisions, but a careful study of the fossil contents, as well as of the stratigraphical relations as shewn in other portions of the field, where the similar rocks appear, shews this peculiar development of strata to belong largely to the lower division of the Trenton and not far from what is designated the Black River division. The equivalence of the areas in the vicinity of Quebec to those seen in the Phillipsburg section has also been very clearly established, and the rocks of the latter are found to range upward from the base of the Calciferous to the top of the Chazy formation. Thence eastward the ascending sequence can be traced upward into the black slates and limestones of Farnham which are apparently the equivalents of those of Quebec city, but which were at one time described as a part of the Potsdam formation.

The great areas of upper Silurian, once depicted on the map of the province of Quebec, have in large part been removed. These were supposed to occupy the greater portion of the province, east of the Sutton mountain range; and their Silurian horizon was maintained from the presence of a number of areas of these fossiliferous rocks found at various places in this district. The detailed study of this field shewed conclusively that these Silurian areas were detached outliers, sometimes of very limited extent, in places infolded with the underlying Cambro-Silurian sediments. The age of the latter was established by the finding of characteristic fossils, such as graptolites and trilobites at a number of points. It can therefore be safely asserted that by far the greater part of the area east of the Sutton Mountain anticlinal is occupied by strata of Cambro Silurian and Cambrian age and that the upper Silurian and Devonian portions are very limited in extent.

The question of the age of the mountain masses of diabase and syenite so conspicuously displayed in the area east of the St. Lawrence, has also been a somewhat difficult one to decide. In places the associated rocks have been so altered as to present the

aspect of Pre-Cambrian schists and for a time these mountains were supposed to be as old as the lowest Cambrian. Their intimate association with Silurian and Devonian sediments at a number of points, together with the fact that numerous spurs were given off from the main masses of igneous rocks which penetrated these newer sediments in the form of dykes, the fossiliferous Silurian and Devonian in contact being frequently converted into schists and otherwise altered, shews conclusively that the age of most of these mountain masses must be more recent than the sediments which they penetrate so that they are at least post-Silurian.

There are however large areas of igneous rocks in association with the pre-Cambrian strata of the Sutton Mountain axis which are of Pre-Cambrian age, since they are overlaid by the slates of the lowest Cambrian. These have also been altered and are now often seen in the form of chloritic and other schists.

The age of the Granite masses which are conspicuous features in the eastern portion of Quebec, is probably not very different from that of the diabase hills just referred to. These cut rocks of all ages from the pre-Cambrian to the Silurian. The strata in their vicinity are all greatly altered, the slates being changed into chistolite and staurolite schists, while the Cambro-Silurian limestones have been rendered schistose and are filled with small scales of mica, often with a large development of quartz veins.

The serpentine areas in which the asbestos of the Eastern Townships is frequently found apparently belong to the diabase and olivine group. They are often found in association with the Cambrian slates but they also occur in connection with the Cambro-Silurian and Silurian strata. They are apparently altered portions of the diabase and olivine masses.

The same remarks apply to most of the igneous rocks of the Gaspé peninsula. There is here a central zone of pre-Cambrian rocks, overlaid on the north by Cambrian slates and limestones, and on the south by Silurian and Devonian strata of the great Siluro-Devonian basin. Through these newer rocks great mountain masses of diabase and kindred rocks protrude; similar to those found in the areas east of the St. Lawrence, and these are evidently newer than the fossiliferous sediments which they penetrate, since, at several points, pieces of the fossiliferous limestones are caught and held in the igneous mass.



